SKA CONSULTING ENGINEERS

Sutton-Kennerly & Associates, Inc.
530 Hendersonville Road
Asheville, NC 28803-2826

Telephone: 828 274 4440
Fax: 828 274 4488
www.suttonkennerly.com

ASHEVILLE CITY HALL
WATER INTRUSION INVESTIGATION
FINAL REPORT

February 16, 2010

Prepared by:

COPY

[redacted]

Zebulon W. Wells, Jr., P.E.

Sutton-Kennerly & Associates, Inc.
530 Hendersonville Road
Asheville, North Carolina

North Carolina License Number F-0508

TABLE OF CONTENTS

COPY

I. EXECUTIVE SUMMARY:

The Asheville City Hall is an attractive art deco style building designed and constructed in the 1920's. It is on the National Register of Historic Places and still serves as the government center for the City of Asheville. Designed by architect Douglas D. Ellington, the building has received praise as a classic example of the art deco style of design.

Currently, the exterior of the building is in a state of deterioration due to the effects of water on the existing building materials. These materials include brick, terra cotta and marble. There has been extensive water leakage into the building and there is a considerable amount of water related damage to the interior building finishes on the seventh and eighth floors.

The exterior of the building was accessed during August and September of 2009, and several inspection ports were opened to assess the condition of the building behind the cladding elements. It was determined that much of the existing mortar in the joints between the existing terra cotta copings on the building is deteriorated and open to water intrusion. There are no flashing materials present below the decorative terra cotta to manage water that penetrates through the terra cotta.

There are steel shelf angles at each floor level that support the brick above the windows on the building. It was discovered that the steel angles are heavily corroded and at some locations, the brick does not have adequate bearing on the shelf angles. It was also discovered that there is no flashing or weeps in the brick at the shelf angles to control water that penetrates the brick. It was also discovered that there are very few ties securing the brick to the building, and those that were discovered, were heavily corroded. At some locations, the brick ties were corroded completely in two. There are also numerous cracks in the brick veneer at various locations all around the building. There is also deterioration of the brick at the base of the building on the north wall. The brick has been covered with a cement plaster that is now spalling off of the building. The spalling of the plaster is believed to be driven by deterioration of the brick behind the plaster due to freeze thaw damage.

There is a parapet around the roof at the second floor level of the building that is capped with marble coping stones. One section of the marble was removed to view the conditions beneath. It was discovered that the marble is not anchored to the building structure. There is a flexible sealant material between the joints in the marble coping as well as at the bed joint between the coping and the supporting brick and marble wall below. It was noted that the sealant in the joints between the stones has failed and allows water to enter between the stones. The sealant between the bottom of the coping stones and the wall below has not failed as badly as that between the joints, and retains water below the coping stones. There is no flashing or other water control mechanism in place below the marble coping.

The windows in the building are approximately twenty years old and appear to be in relatively good condition at the lower floors. The windows at the seventh and eighth floors are the exception to this. The fixed and operable sash assemblies are loose in the aluminum window frames and the operating mechanisms of the operable sashes have failed and in some instances, fallen out of the frame. The existing sealants between all of the window frames and the building cladding materials have failed at most locations.

We recommend that new flashings be incorporated into the building cladding at all key locations all around the building including below all copings and at all shelf angles. We also recommend that new stainless steel retrofit brick ties be installed in the brick veneer all around the building. All existing brick and terra cotta on the building that is cracked, spalled, or otherwise damaged should either be repaired or replaced. The existing windows at the seventh and eighth floors should be disassembled and repaired. The existing sealant materials around all window and door openings should be removed and replaced.

It is estimated that the total budget cost of these repairs should be a $4,348,380. This estimate includes all of the recommended repairs, general conditions of the contract including permits and insurance, access to the building, a contingency for unknown or hidden conditions and design and contract administration services.

The seventh and eighth floors of the building are currently unoccupied. However, it was requested that an estimate be generated of the scope of work that would be required to condition this space. It is estimated that the total cost to condition the existing space including new equipment, construction costs and design services will be approximately $743,000.

It is estimated that the entire time of construction for the repairs will be twenty four to thirty six months. This time does not include design time. It is estimated that six months will be required for the design phase of the project. It is strongly recommended that an area be designated to be repaired before the project is bid so the effectiveness of the proposed repairs can be tested and the aesthetics of the repairs can be evaluated and approved by both the City and the Historic Resources Commission. Any modifications to the repair details can then be made before receiving bids for the work. An additional two to three months will be required for advertising, bidding and preparation of contracts for the construction to proceed.

II. BACKGROUND AND DESCRIPTION:

The Asheville City Hall Building is a nine story steel framed structure housing municipal government offices. The space up through the eighth floor is occupied space with the floors above the eighth being occupied by mechanical rooms and the belfry floor and roof. The building was designed by Douglas D. Ellington and was constructed in the 1920's. The building is on the National Register of Historic Places and serves as a prominent visible emblem of the City.

The building is clad with a variety of materials including brick, marble and terra cotta. Most of the upper floors of the building have a brick veneer installed over a variety of backup materials including brick and clay tile. The upper portions of the building are clad with decorative terra cotta units of various sizes and shapes that also serve as copings for the upper parapet walls. There are also decorative terra cotta piers on all four sides of the building. The lower areas of the building are clad with brick on the south, east and north sides of the building. The front elevation is clad in pink tinted marble from grade level to the second floor level. There are three large windows on the west elevation of the building that extend from the second floor level up to the bottom of the fourth floor. There is a vehicular ramp on the south side of the building that furnishes vehicle access to the basement level of the building. The steel structure below this ramp was restored in the early 1980's.

There have been ongoing issues with water intrusion into the building for several years and a number of repairs have been made to address the water intrusion issue, none of which have been ultimately successful. There is some information available on the repairs that have taken place on the building; however, the information is limited. The evidence of some of the repair efforts is still visible on the exterior of the building. Currently, the seventh and eighth floors of the building have active water leakage and there is active mold growth in the occupied spaces at several locations, most notably at the northeast corner of the building at the seventh floor level. The eighth floor of the building is not occupied at this time. There is significant damage to the existing dropped ceilings at the seventh and eighth floors and severe deterioration of the plaster finishes on the interior walls on these floors. Some years ago, there was also deterioration of the plaster finishes around the windows in the snack bar area on the ground floor of the building. This damage has since been repaired, and no additional deterioration of the plaster is visible.

The building is configured in tiers and has ten distinct isolated roof areas at various elevations. The roof levels include a tiled cupola and the tile covered octagonal roof at the center portion of the building, four inset roof levels at the eighth floor level at each corner of the building and four inset roofs at the corners of the building at the seventh floor level. There a narrow roof at the second floor level that surrounds the building on the north, east and south sides of the building and approximately one third of the west elevation of the building.

The existing clay tile cupola roof and stepped octagonal tile roof on the building were removed several years ago. A new waterproofing membrane was placed below the clay tile and the tile was then replaced. There is a concealed gutter that encircles the building below the edge of the octagonal roof. The gutter is lined with lead coated copper with soldered joints, based on the information available. The existing flat roofs at the second, seventh and eighth floors were also replaced within the last several years.

The scope of this investigation was to evaluate the existing condition of the exterior of the building in an effort to determine the source of water leakage into the building, assess the condition of the existing cladding materials on the building and to develop recommendations for any repairs that may be needed.

During the course of the investigation, scaffolding was erected on the north and south elevations of the building from the second floor level to the top of the eighth floor. Some of the existing brick was removed at approximately twelve locations to allow a visual evaluation of the conditions present behind the brick veneer. In addition, several of the existing terra cotta sections were removed from the tops of the parapet walls at the northeast and southwest corners of the building. At the second floor parapets there is a marble coping in place at the top of the walls. One section of the existing marble coping was removed from the top of the parapet wall on the south side of the building.

III. CONDITIONS NOTED:

A. Roofing:

The flat roofs are covered with a granular surfaced modified bitumen roofing membrane. The roofing membrane continues up to the top of the inside face of the parapets and is terminated at the base of the enclosed building walls. The roofing membrane itself appears to be in relatively good condition at this time. However, there is water present below the roofing membrane at many locations that is evidenced by blisters in the membrane that flex visibly when touched. City personnel stated that the flat roofed areas have been evaluated several times by a local roofing contractor, but no significant leakage of the roofing membranes was discovered. Some minor repairs may have been made to the roofing membranes, but no information is available regarding the types of repairs that were made. However, the leaks inside the building have continued essentially unabated after the repairs were made.

B. Terra Cotta:

As noted before, several various repairs have been completed on the building over the years. At the upper floor levels, there is evidence of a black colored material that was placed over the mortar joints in the brick and the terra cotta sections all around the top of the building. Staining from the black material is visible on the brick and the terra cotta, but for the majority of the mortar joints, weathering of the mortar has resulted in the loss of the coating materials. It was learned that the terra cotta was coated with thin coating material in the early 1990's in order to bring the color of the terra cotta to a more uniform appearance around the building. At this time, there are visible whitish stains on the sides of the building that we believe are traces of the coating material applied to the terra cotta.

There is significant damage to many of the sections of terra cotta all around the upper levels of the building. In some instances, there is crazing of the glazing on the terra cotta and in many areas, the glazing on the face terra cotta has spalled off completely. In many locations, the terra cotta is severely cracked and open to water intrusion. Some of the terra cotta units have been repaired in the past with what appears to be an epoxy material. The mortar joints between the terra cotta units are typically cracked and separated creating a path for water to enter between the units. Significant areas of moss growth were noted in mortar joints between the terra cotta sections on the north and south walls of the building. The presence of moss indicates that a consistent source of moisture exists to keep the moss supplied with water to sustain it.

Several of the terra cotta units were removed to view the conditions below the units. At some locations, water was present in the wall construction below the terra cotta. There was no flashing of any kind present below the terra cotta. The intent of flashing materials is to direct water that penetrates the cap material back to the outside of the wall construction. Without any system in place to collect and redirect water, any water that penetrates the wall can migrate essentially down the full height of the wall system or into the interior of the building.

The terra cotta where sections were removed is anchored to the building by a continuous steel bar running parallel with the longitudinal axis of the wall. The bar is anchored into the wall with hooked steel rods set in the mortar joints just below the bottom of the terra cotta caps. There is what appears to be a bronze wire that wraps around the steel rod and extends up into the mortar joints between the terra cotta units. At some locations, we believe that a galvanic reaction has occurred between the steel bar and the wires. This has resulted in the steel being corroded almost completely in two where it makes contact with the bronze wire. It was noted that the wire is typically only embedded in the mortar joint and does not penetrate into the voids in the hollow terra cotta units.

C. Brick:

In general, the brick on the building appears to be relatively sound. We have been advised by the architect who designed renovations and repairs to the building in the early 1990's that the brick and the mortar joints were "sacked" with a brown mortar to make the appearance of the brick more uniform. Sacking is a process where mortar is essentially rubbed onto the face of the brick using a section of burlap or other heavy cloth type material. This leaves a thin coating of the mortar on the face of the brick and mortar joints and improves the appearance of the wall. However, this method does little if any good to help the brick resist water intrusion.

It was noted that there are numerous and extensive cracks in the brick at various locations all around the building. At the inset roof areas on the seventh floor, there is a vertical crack in the brick that aligns with the inside face of the parapet walls around the roof area. The crack in the brick is in the face of the brick that is supported at the roof level. This condition is typical at most locations where the brick transitions from the full height wall on the building sides to the shorter wall above the roof level at the inset roofs.

The corners of the building are mitered from the third floor through the seventh floor. There are four stepped brick buttresses at the corners of the building below the mitered corners that transition the shape of the building to square corners. The tops of the buttresses are constructed of stepped brick that slopes down and away from the mitered corners of the building. The brick at the sides of the stepped buttresses is cracked away from the stepped brick forming a continuous crack approximately ¼" wide. It was also noted that the brick is cracked vertically where the flat side walls of the building intersect the brick at the mitered corners of the building. These cracks extend for the entire height of the brick from the tops of the buttresses at the third floor level to the tops of the parapets at the seventh floor level.

There are numerous cracks in the mortar joints at various locations all around the building. At some locations, the mortar in the joints has completely loosened and has fallen out of the joints. At some locations, the brick is cracked and spalled at the upper corners of the window openings.

Upon removing the brick at several locations, it was noted that the angles that support the brick over the windows are continuous around the building. At the upper floor levels, the shelf angles supporting the brick are severely corroded. The degree of the corrosion on the shelf angles is less at the lower floors of the building; however extensive corrosion was noted at most locations. No significant corrosion of the steel supporting the shelf angles was noted at the limited number of locations where inspection ports were cut in the brick. There was no flashing material of any kind found at the shelf angles. Neither were any weeps noted in the brick to allow water to evacuate from behind the brick veneer. It was noted that the brick and mortar is built up tight against the bottoms of the shelf angles with no room being furnished for any differential movement between the brick and the steel structure.

A few metal ties securing the brick to the back up material were found during the investigation. The ties that were discovered were thin flat sections with little deformation in the tie to help secure it in the mortar joints. All of the brick ties discovered were heavily corroded, with some being corroded completely in two.

At many locations, there is as little as 1" of the brick being supported on the angles. At one location over a window at the sixth floor level on the south wall of the building, a significant bow was noted in the brick immediately above the window. It was noted that the original brick at this location has been replaced with newer brick at some time. It was also noted that the brick bears only about 1" on the supporting shelf angle at this location. It is estimated that the brick bows outward approximately 2" above this window.

At the base of the building from the ground floor level to grade on the north wall of the building, the brick is covered by cement plaster. It was noted that the cement plaster is cracked and debonded from the brick at several locations. At some locations, the cement plaster has spalled off of the wall revealing the brick behind it. The brick is extremely soft and deteriorated behind the plaster.

D. Marble Coping at Second Floor Parapet:

One section of the marble coping was removed from the top of the parapet wall on the west side of the building at the second floor level. It was noted that the joints between the marble coping stones were sealed with an elastomeric sealant material that appears to be polyurethane. The sealant in the joints is very weathered and has failed at most locations, allowing water to penetrate between the coping stones. It was also noted that the joints at the base of the coping stones were also sealed, effectively trapping any water that penetrates between the coping stones. There is extensive biological growth on the face of the sealant between the coping stones and the brick masonry below. When the stone was removed, there was water below the coping stone on top of the brick masonry below. It was noted that there is a separation between the outer wythe of marble and the inner wythes of brick masonry below the coping approximately ½" wide below the coping stones. There is no flashing present below the copings to collect water that penetrates the joints between the stones. The water that does penetrate the joints between the stones migrates freely down into the wall below.

E. Windows:

The information available at this time indicates that the windows in the building were replaced in the early 1990's when the building was renovated. It was noted that the elastomeric sealant installed between the window frames and the brick have failed all around the building. The windows at the seventh floor level extend from the seventh floor to the roof level and are trapezoidal in shape. The windows have operable sashes, but the operating mechanisms have failed. Some of the operating mechanisms are hanging loosely outside the windows at a few locations. The fixed portions of the trapezoidal windows are loose in the frames and are easily moved by hand at some locations.

IV. OPINIONS AND CONCLUSIONS:

In our opinion, it is evident that there are numerous significant issues related to moisture intrusion on the Asheville City Hall Building. This is an ongoing issue that has persisted for years in spite of a variety of efforts made to prevent water from entering the building. Most of the efforts made to control water entering the building have been focused on trying to keep water out of the building walls and roof. None of the methods employed to date have made any significant effort to effectively manage water that does enter the walls of the building. While brick, stone and terra cotta are typically viewed as being waterproof, they are not totally so. These materials are water resistant to a point, but can still absorb moisture. The mortar used in the joints between the brick, stone and terra cotta is a highly porous material that will readily absorb moisture. As cracks develop in the mortar, water can be drawn into the building through capillary action. This can result in large quantities of water penetrating the building walls. Due to the nature of the materials, water penetration into masonry walls cannot be stopped entirely. While there are methods that can help reduce the amount of water that penetrates the masonry walls, none can completely stop it. Therefore, it is imperative that some means of managing the water that does penetrate the building walls be incorporated into the construction. In the era when this building was constructed, the state of the art of building construction did not include water management in the exterior building finishes. It was assumed that the brick, stone and terra cotta finish materials on the exterior of the building were relatively impervious and furnished a sufficient degree of water resistance to protect the structure.

Since the time when this building was constructed, significant advances have been made in building technology. It is now acknowledged that all buildings do in fact allow water to enter the building to some degree. There is much more attention now given to managing the water that does enter the building. It is now known that water that is not effectively managed with the building walls can have an extremely detrimental effect on building materials, the environment inside the building and on the structure supporting the building.

This building is now showing all of these detrimental effects of water penetrating the exterior walls. The ongoing water penetration into the seventh and eight floors of the building is, in our opinion, a direct result of the lack of a water management system being present in the walls along with a lack of adequate maintenance of the exterior of the building. Water damage to the ceilings, wall finishes, the presence of biological growth on the walls and corrosion of the steel structure are all, in our opinion, directly related to the passage of water through the walls of the building.

Because there is no way for water that does enter the building walls to be directed back to the exterior of the building, it migrates inward and downward from the point of entry. The tops of the parapets are more exposed to the elements and are more susceptible to water intrusion. We believe that the terra cotta parapet walls at the seventh and eighth floors of the building are a major source of water into the building.

Some issues discovered during the investigation are safety concerns. The lack of ties securing the brick to the building and the condition of those that were found is a major concern. Several locations were discovered where the brick bears less than two-thirds of the thickness of the brick on the shelf angles is also a major safety concern. Inadequate brick bearing and a minimal quantity of ties securing the brick combine at those locations to make the conditions very serious in our opinion.

A. Roofing:

The investigation did not include any evaluation of the roofing on the octagonal portion of the roof above the eighth floor level. Since this roof was recently replaced, it is assumed that it is functioning properly at this time. This investigation includes only the existing roofing on the roofs at the second, seventh and eighth floor levels.

The existing roofing at the second, seventh and eighth floor levels is a granular faced roll type roofing. The age of the roofing on these areas is not known. While the roofing material appears to be in relatively good condition, the fact that there is water present below the roofing at many locations makes replacement of the roof prudent. The installation of the roofing up the inside face of the parapets is a condition that should be avoided. While roofing materials placed on the wall help to prevent moisture entry at the face of the wall, more importantly, it prevents the wall from drying adequately. The accumulation of moisture behind an impervious material such as roofing membranes can lead to failure of the wall materials. The parapets on this building are all assumed to be brick construction since brick is visible above the roofing material at the parapets at the second floor level. As moisture trapped behind the membrane freezes in the pores of the brick, it causes the brick to fracture and spall as the freezing water expands. This action is very detrimental and can lead to significant damage to the brick parapets.

It is our opinion that the existing roofing on these areas should be replaced after all necessary repairs have been made to the remainder of the building. The replacement of the roofing should be the last repair completed because repairs to the other areas of the building will need to be staged off of these roofs. Therefore, the roofing in these areas will be subject to significant foot traffic and material storage. It should be anticipated that the existing roofing will be damaged to some extent by these operations.

B. Terra Cotta:

Architectural terra cotta is a clay based material that is molded and formed into a variety of shapes and designs. As a building cladding, a wide range of architectural effects can be achieved using terra cotta to simulate carved stone. It was a very popular building construction material from the late eighteen hundreds into the 1930's. Terra cotta is lighter than stone and is easily formed into the desired configurations. Typically, intricate terra cotta pieces are hollow cast to make them lighter and easier to handle. After the pieces have been cast, they are baked in a kiln at high temperatures to produce a material similar to ceramic. Terra cotta is usually glazed with a compound that reacts during the firing process to produce desired colors and finish textures on the finished product. Glazed terra cotta is a durable finish material that is resistant to color fading if maintained over time. Terra cotta is very weather resistant; however, it is not impervious to the effects of weathering.

At the height of architectural terra cotta use in building construction, it was often considered to be totally waterproof and impervious to the effects of weather. Because of this misconception, it was not believed that flashings, weeps or other methods of water control were necessary. It was found over time that this is not the case. Terra cotta and the materials used to incorporate it into the building are very susceptible to weathering.

Some of the problems associated with terra cotta include crazing of the glazing, spalling of the glaze, loss of cross section of the terra cotta units, deterioration of the mortar in the joints between units and deterioration of the metal anchorage systems used to secure the terra cotta to the structure.

Because terra cotta is a kiln fired material, all moisture is driven out of the material during the firing process. When the finished terra cotta section is taken from the kiln, it has the smallest volume that it will ever have. Clay based materials have an affinity for moisture, and the terra cotta units over time do absorb moisture from the environment. As moisture is absorbed, the terra cotta units expand slightly. The glazing on the terra cotta does not always have the ability to accommodate expansion of the base material. As a result, the glazing can develop small cracks called crazing as it goes into tension. This condition is present to some degree on this building.

Spalling of glazing from terra cotta is a common form of deterioration. Spalling can range from small pop outs in the face of the terra cotta to the loss of the entire glazed face of the unit. Spalling is typically caused by moisture being trapped within the clay body of the terra cotta behind the glazing. This can be caused by the absorption of atmospheric moisture within the clay base or by water that enters the material through mortar joints, cracks or other defects within the construction. Moisture trapped behind the glaze migrates toward the exterior of the terra cotta back where it can normally evaporate into the atmosphere. The relatively impervious glazing prevents the migration of moisture. As the moisture accumulates, pressure builds up behind the glazing until the tensile strength of the glazing and or the clay base is exceeded. This is exacerbated where temperatures below freezing occur regularly. Significant changes in temperature causes freeze thaw cycling. As moisture freezes, it expands, resulting in the glazing and or clay base of the terra cotta being fractured. Asheville is a location where freeze thaw cycles can occur on a daily basis during the winter months.

When the glaze ruptures exposing the clay base, more water can be absorbed into the terra cotta leading to additional spalling of the base material. Spalling of terra cotta can also be caused by inadequate allowance for movement of the terra cotta or accommodation of movements of the structure. Spalling can also be caused by corrosion of the metals used to anchor the terra cotta to the structure.

Deterioration of the mortar between the terra cotta units is a major source of water entry into the system. Mortar itself is a porous material that will absorb moisture. However, if the water is controlled and the mortar can dry effectively, it is quite durable. When cracks develop in the mortar and between the mortar and the terra cotta units, significant volumes of water can freely enter the system. Without a functional water control method integrated into the construction, water leads to a further and extensive deterioration of the entire construction including the terra cotta, metal anchorages and in some cases, deterioration of the supporting structure. As the deterioration of the mortar progresses, it accelerates as more water is allowed to enter the system. Water entry into the system also exposes the tile body of the terra cotta to water. Failed and deteriorated mortar is one of the most prevalent sources of water entry and deterioration of terra cotta and feeds many of the types of terra cotta deterioration. Other sources of water into the system include failed or nonexistent sealants where the terra cotta abuts dissimilar materials.

Another source of damage to terra cotta is stress related movement. At the time when this building was constructed, little provision was made for differential movement between the building structure and cladding materials. Similarly, little if any provision was made for differential movements between dissimilar materials. No movement joints were noted in this building to accommodate expansion and contraction of the terra cotta due to moisture absorption or thermal movements. The change in volume of terra cotta due to moisture absorption can lead not only to crazing of the glaze on individual units, but is an accumulative change that can cause significant cracking of the relatively rigid terra cotta material. The change in volume due to moisture absorption is an irreversible change in volume. The total change in volume sometimes takes years, and in the case of this building, volume change due to moisture absorption occurred long ago. Changes in volume of the terra cotta also occur due to variations in temperature. As the material heats and cools, it expands and contracts according to the thermal properties of the material. Thermally driven changes in volume must be accommodated, as well as volume changes due to moisture absorption.

It is our opinion that proper maintenance of the mortar joints in terra cotta and a properly designed water management system are essential in maintaining the terra cotta and extending the useful life of the material. Sound mortar helps to keep most of the water out of the system; however, some water entry into the system is inevitable. Therefore, incorporating a system of flashings and weeps into the terra cotta installation is required to control the water that does enter into the system.

On the Asheville City Hall building, several attempts have been made to keep water out of the terra cotta and brick on the building. One of the most noticeable is what appears to have been a bitumen based material applied over the mortar joints in the terra cotta and brick. It is our opinion that this method is not only ineffective, but can in some cases exacerbate the deterioration of the terra cotta and brick by preventing moisture from evaporating out of the system. In discussion of previous repairs made to the building, it was learned that the terra cotta was coated with a material specifically developed for terra cotta. These materials are typically acrylic based paints that have a useful life of five to ten years. When viewed from a distance, discoloration of the building is visible below the terra cotta on the upper reaches of the building. Based on the information available, we believe that this coating is now failing and is being washed off of the terra cotta and onto the brick below, giving the upper portion of the building a slight "white washed" appearance. The remnants of the bituminous sealant applied over the mortar joints is also visible upon close inspection, more so on the brick than on the terra cotta.

C. Brick:

Brick masonry makes up the majority of the cladding on the Asheville City Hall. Above the second floor level, the vast majority of the cladding is brick with the terra cotta being used as a coping material for the top of the brick. The first and second floors of the building are clad with marble. Below the first floor level, the building cladding is brick. On the north side of the building, the brick is covered with a cement plaster from the ground floor level to existing grade. A significant amount of cracking of the brick was noted at all locations on the building.

Brick, like terra cotta is a clay based material that is formed and fired in a kiln. While brick can be glazed, it is not typically. Brick develops a hard outer layer that helps make it water resistant; however, it is not impervious to water penetration. Depending on their placement within the kiln, some bricks are fired to higher temperature than some others in the same batch. Higher firing temperatures result in harder bricks that are more resistant to moisture than those that do not reach higher temperatures. Lower firing temperatures result in softer brick that is much more absorptive. Some bricks produced in the eighteenth and early nineteenth century could absorb as much as 30% of their weight in water. From the late nineteenth century on, 10% water absorption or less was considered to be the allowable maximum. Brick that has lost the hard outer layer is typically more susceptible to water absorption.

Being a kiln fired clay based material; brick is totally dry when exiting the kiln and begins to absorb atmospheric moisture over time. The absorption of moisture results in an expansive change in volume that must be accommodated as the brick is placed in service. This is typically done by creating horizontal and vertical joints in the brick that are filled with elastomeric sealant materials which allow for movement of the brick while maintaining a weather resistant seal. Brick also expands and contracts due to changes in temperature. When movement joints are designed, the total expansion of the brick due to moisture absorption and thermal expansion must be considered, as well as accommodating shrinkage due to lower temperatures. Allowances must also be made in brick construction to accommodate structural movement and differential movement of adjacent dissimilar materials. No sealant joints to accommodate moisture related movement, thermal movement or structural movements were noted on this building. The lack of movement control joints in brick construction can result in various types of deterioration of the brick including cracking of the brick, spalling of the brick and the movement of the brick away from the building. There are various cracks in the brick veneer on this building that, in our opinion, were caused by brick movement that was not accommodated in the original building design.

At many locations, differential movement has occurred in the brick veneer. Differential movement is evident at locations where the geometry of the brick changes, such as building corners and where the support of the brick changes. There are cracks in the brick where the mitered corners of the building meet the brick on the sides of the building. There are also changes in geometry where the brick is recessed along the sides of the building. There are also cracks in the brick where the buttresses at the third floor level transition into the mitered corners. The brick at the sides of the building continues out to form the rectangular corners between the second and third floors, while the brick above turns at a 45 degree angle. Expansion of the brick on the sides of the building causes cracks to form in the tops of the buttresses in our opinion.

There are steel shelf angles to support the brick on this building. The shelf angles are connected to the steel structure and are continuous over the window heads serving as lintels over the windows. The brick veneer from the second floor up begins at the second floor level and extends continuously from the second floor level to the top of the eighth floor. The mortar joints where the shelf angles occur is solid. At those locations where brick was removed, the brick below the shelf angle was notched to clear the shelf angle. As a result, the full height of the brick from the top of the eighth floor down is supported on the structure at the second floor level. The typical design of shelf angles allows the load of the brick on the structure to be spread out and supported at each floor level. For the design to function effectively, brick expansion control joints must be furnished at each shelf angle. Because the mortar joints are solid at the shelf angles and no brick expansion control joints were incorporated into the construction, the brick veneer is essentially one large section of brick bearing only at the second floor level.

Where the rising walls occur at the inset roofs at the seventh floor, the brick on the sides of the building is continuous from the second floor up to the eighth floor roof level. The brick at the building walls inside the inset area is supported at the seventh floor level. The expansion of the brick on the outer sides of the building is accumulative, and the brick on the outside walls has moved relative to the brick supported at the seventh floor level. It is our opinion that this differential movement has resulted in the formation of cracks in the brick veneer above the seventh floor parapets.

The existing brick is cracked badly at some of the upper corners of the window openings. We believe that this cracking is related to a stress increase in the brick at the edges of the window openings. As the brick expands from the second floor upward, an accumulative upward movement of the brick occurs. There is no accumulation of brick movement where the window openings occur. Therefore, the stresses in the brick transition from a high stress condition to a zero stress condition near the edge of the window opening. Since the brick is unconfined at the edge of the window, the brick moves outward causing the cracks at the back edge of the brick just below the shelf angle.

The mortar in the joints between the bricks is a very porous material that will readily absorb moisture. This is especially true at horizontal brick surfaces. The tops of the stepped buttresses at the four corners of the building are examples of locations where waterproofing can be very difficult to achieve. There are also cracks and voids in the mortar between the bricks at many locations. All of these conditions allow water to penetrate the brick. Once behind the brick, there is no flashing at the shelf angles to capture water that penetrates the brick and divert it back to the exterior. In addition, there are no weeps in the brick to help facilitate drainage of moisture back to the exterior. Weeps in the brick can also help in the drying process of the wall from moisture penetration in periods of drier weather by allowing ventilation behind the brick.

Water that enters the walls of the building causes numerous types of deterioration. There is significant corrosion of the shelf angles supporting the brick and the ties used to secure the brick to the backup material. It is our opinion that the corrosion of these elements is due to excessive water penetration into the brick and the lack of any flashing or weeps to redirect the water back to the exterior of the brick. The scarcity of brick ties and the deterioration of those that were found on this building are a major cause for concern. The brick on the building is an exterior veneer applied over a steel frame with masonry infill. The exterior brick is an element that relies upon the backup material for lateral support. The mortar infill between the backup materials and the inside face of the brick veneer served as a bond between the back up and the brick veneer as constructed. As movement of the brick veneer takes place, this bond can be broken.

At many locations, it was noted that the brick bearing on the shelf angles was not adequate to fully support the brick. At some locations, the brick bearing was as little as 1". This creates an eccentricity in the brick support, causing an outward force pulling the brick away from the building. It is our opinion that this is a potential safety concern if the brick should separate from the backup structure. This is especially significant due to the lack of adequate ties securing the brick to the structure.

The brick between the lower floor level and the existing grade on the north side of the building is covered with cement plaster at this time. The original building drawings show the brick at this location, but no plaster is indicated. The plaster is failing in a few areas. At one spalled location, the brick behind the plaster is visible. It was noted that the face of the brick, as well as the plaster, is spalling. It is our opinion that the spalling of the brick and the plaster is caused by water entering between the brick and the plaster above. During freeze thaw cycles, expansion of the freezing water is causing the brick to spall away. It is not known when or why the plaster was added. It is possible that spalling of the brick prompted the installation of the plaster in an effort to protect the brick surface from deterioration. It was noted that there is marble cladding above the brick on this elevation of the building. There is discoloration in the joints between the marble sections and the marble steps out just above the beginning of the plaster covering. The source of the water getting behind the plaster is not known. The water may be entering at the top of the plaster wash, or may be gaining access to the building at a point higher up within the marble cladding.

D. Marble Coping at Second Floor Parapet:

The marble copings on the parapets at the second floor have failed sealant joints between the stones. The bed joint where the stone sets on the wall below is also sealed at the bottom of the marble. These two conditions join to trap water below the marble. The open joints between the stones allow water to penetrate between the stone sections, while the sealed joint at the bottom of the stone prevents the water from escaping.

There is no flashing present below the marble coping at the second floor. Nor is there any anchorage of the marble coping to the top of the parapet. Therefore, the marble coping is basically just held in place by the mortar bond and gravity. The parapet is constructed of brick with a marble cladding on the outside face. There is a separation between the brick parapet and the marble that is open to water intrusion. The lack of flashing allows water entering between the coping sections to freely enter the wall below.

E. Windows:

The windows on the building are relatively new, and are mostly in good condition. The exceptions are the windows at the seventh floor levels. The windows at the seventh floor are, in our opinion, in poor condition and are in need of repair or replacement. At some locations, the fixed glass panels appear to be loose and can be moved by hand. The operable sashes at some locations are very loose and the operating mechanisms are falling out of the windows. The condition of these windows allows water to enter the building, as well as significant heat loss and gain due to free air passage through the windows.

At all locations that were accessed on the building, the sealants between the window frames and the cladding materials have failed. The failure of the sealants around the windows allows significant water and air infiltration into the building. Water entering around the windows can directly enter the building walls resulting in deterioration of the both the interior and exterior building finishes. As with water intrusion at any location, deterioration of the structural components is also inevitable.

V. RECOMMENDATIONS:

Based on our observations of the existing building and the conditions that were discovered, we believe that extensive renovations and repairs to the exterior of the building are required to restore the weather tight integrity of the building and help ensure its continued viability. The degree of water infiltration into the building envelope and the damage that has already occurred dictate that the repairs should be undertaken as soon as possible.

A. Roofing:

We recommend that the existing roofing and insulation be removed at the second, seventh and eighth floor levels down to the concrete roof deck. This step in the repair process should be the last thing done after all of the repairs to the terra cotta and brick have been completed. The existing roofing materials that are on the inside face of the parapets should be removed as the brick repairs are completed so the repairs to the brick on the parapets can be made concurrently with the other brick repairs. This will require that the existing roofing be cut approximately 8" above the existing roof level and a temporary termination bar installed.

We recommend that all existing roof drains be checked to ensure that they are properly sized and that they are flowing properly. We recommend that new tapered insulation be installed to ensure that water is drained properly to the existing roof drains. A minimum slope of 1/8" per foot should be maintained to ensure adequate drainage of the roofs. A new insulation protection board should be installed over the insulation and a new single ply thermoplastic roofing membrane be installed over the protection layer. The new roofing membrane should be terminated approximately 8" above the finished roof level with a sealed termination bar and lead coated copper counter flashing installed over the roofing termination.

In conjunction with the roofing work, the existing concealed gutter around the base of the octagonal roof should be thoroughly inspected. The existing corroding flashing materials at this level should be removed and replaced with new lead coated copper flashing fabricated to match the existing. The existing lead coated copper lining of the concealed gutter should be repaired as the discovered conditions dictate.

B. Terra Cotta:

We recommend that all of the existing terra cotta copings be removed. This would include all of those pieces of terra cotta that are exposed at the top of the walls and the monumental piers on each face of the building. Each piece of the terra cotta must be marked as it is removed from the building and a diagram of the terra cotta pieces must be made to ensure that the individual pieces are reinstalled in the same location where they were removed. After the terra cotta has been removed, each piece should be carefully examined and repaired if necessary. Some of the terra cotta is severely damaged already and will need to be replaced with new pieces that are custom made to match the existing. It is anticipated that there will be some unavoidable damage to the terra cotta as it is removed. These pieces, too, should be repaired or replaced as necessary.

As the terra cotta pieces needing replacement are identified, if they are typical of other pieces, an intact piece should be taken so a mold can be made to duplicate the piece. Pieces that are one of a kind will need to have a model made of them before they are removed for making of the replacement piece.

While the terra cotta coping is off the building, the existing anchorages for the terra cotta should be removed and replaced with a new anchorage system. It is our recommendation that all of the existing anchorage systems be replaced with a highly corrosion resistant anchorage system, such as stainless steel. We recommend that the new anchorage system be configured the same as the existing anchorages.

We recommend that a new flashing system be installed on the existing walls where the terra cotta copings are removed. The new flashing should be a combination of lead coated copper and a flexible flashing system designed to capture water that penetrates the terra cotta coping and divert it back out of the wall system. The anchors securing the terra cotta coping in place should be sealed around as the new flashing is installed. As the terra cotta is replaced, weeps should be installed in the bed joints of the terra cotta to allow water to escape and to aid in drying.

Finally, the terra cotta should receive a thorough cleaning with water and mild detergents to remove any accumulated grime and mortar. If necessary after cleaning, consideration of a coating system for the terra cotta may be recommended to ensure that the color and appearance of the material is uniform all around the building.

C. Brick:

Our first recommendation regarding the brick is to install retrofit brick ties to all of the brick all around the building. Since very few brick ties were found during the investigation, and those were heavily corroded, the stability of the brick connection to the structure is in question. We recommend that new stainless steel spiral ties be installed in the existing brick at a spacing of 16" center to center horizontally and 24" center to center vertically. The new ties would be installed in the existing mortar joints in the brick so the installation would not be visible in the brick. This will help ensure that the brick veneer remains stabile as the remaining repairs are completed.

We recommend that approximately six courses of brick be removed at each shelf angle all around the building. Five courses of brick should be removed above the shelf angle and one course of brick should be removed below the shelf angle. As the brick is removed, the brick above the removed section should be shored at intervals not to exceed 4'-0".

While the brick is removed, the existing angles should be closely examined to determine how much of the original steel cross section has been lost to corrosion. Where more than 10% of the original thickness of the angle has been lost, the affected section should be cut out and replaced with a new section of angle having similar dimensions to the existing.

The angles should also be measured to ensure that a minimum of two thirds of the width of the brick veneer is supported on the shelf angle. Where less than two thirds of the brick is supported on the angle, the angle should have a steel extension welded to it. The thickness of the added steel should match the thickness of the existing shelf angle.

After all necessary repairs have been made to the shelf angles, all accessible surfaces of the angles should be cleaned of all corrosion and corrosion by products. The cleaned surfaces should be equivalent to SSPC SP-3, Power Tool clean. After cleaning, all accessible steel should be painted with a minimum of two coats of a corrosion inhibiting high build aluminum filled epoxy mastic paint. After painting with the corrosion inhibitive epoxy, the portions of the angles that are exposed to view such as over the window openings should be coated with two coats of a high build polyurethane paint.

After the shelf angles have been repaired and painted, a new flashing system should be installed at the shelf angle. The flashing should consist of a flat section of lead coated copper flashing material with the outer edge broken to furnish a hemmed edge extending to the face of the brick above. The flashing should then be formed to create a horizontal brick expansion joint at the front of the shelf angle. The brick below the shelf angle should be cut to furnish a minimum 3/8" space between the top of the brick and the bottom of the shelf angle and replaced. The space between the cut brick and the bottom of the shelf angle should be filled with a compressible foam filler material.

A flexible self adhering flashing membrane should be installed on the flat lead coated copper flashing installed on the shelf angle. The flexible flashing should extend to within 5/8" of the face of the brick on the flat surface of the lead coated copper flashing. The flexible membrane should be turned up a minimum of 8" onto the back up material and terminated with a stainless steel termination bar. The termination bar should be secured to the backup material using non corrosive fasteners spaced at 12" center to center. The termination bar should have an integral caulking tray at the upper side of the bar. This tray should be filled with a sealant material that is compatible with the flexible flashing membrane.

The brick above the shelf angle should be reinstalled on top of the new flashing system. The brick should have louvered weeps installed in the head joints in the brick directly above the flashing at 24" center to center maximum. After the brick has been installed and the mortar is allowed to cure for a minimum of 28 days, the joint between the bottom of the lead coated copper flashing and the brick below the shelf angle should be filled with a high quality elastomeric sealant.

At roofs on the second, seventh and eighth floors, a similar flashing system should be installed approximately eight inches above the finished roof level. However instead of the 180° hemmed outer edge on the lead coated copper flashing, the outside edge of the lead coated copper should be hemmed to form a receiver for a piece of lead coated copper counter flashing. The counter flashing should be installed over the termination of the new roofing membrane. This flashing would be installed all around the perimeter of all of the roof areas.

Where the brick on the main building walls extends above the parapets at the inset roof areas on the seventh and eighth floors, the existing damaged brick should be removed from the top of the lower parapet to the bottom of the coping on the wall above the parapet on the wall face that turns into the inset area. As the brick is replaced, a new ¾" wide vertical brick expansion control joint should be constructed into the new brick. The new brick expansion joint should occur at the back face of the brick on the full height face of the building. The resulting joint should be sealed with a closed cell backer rod and a high quality elastomeric sealant.

At those locations where the brick steps in to create a vertical reveal in the walls, we recommend that a brick expansion control joint be installed. The creation of this joint will require that the brick be removed in a vertical strip at the edge of the outside brick. The brick at the outset panel should be cut to form a joint ¾" wide by ½" deep and replaced. The resulting joint will generally be hidden from view and will allow free horizontal movement of the brick at the joint. The joint should be filled with a high quality elastomeric sealant.

At the brick between the ground floor level and the existing grade on the north face of the building, we recommend that the existing plaster covering be removed so the condition of the brick below the plaster can be better evaluated. At that time, a decision can be made whether to restore the brick to its original appearance or to reinstall the plaster covering over the brick. Based on the information available at this time, we would recommend that the brick be restored to its original appearance.

At the brick below the ground floor level, we recommend that all cracked and or deteriorated brick be removed and replaced. Concurrent with replacement of the damaged brick, we recommend that new vertical brick expansion joints be saw cut into the existing brick veneer. The new joints should occur within 10' of the corners of the building and should be spaced at a maximum of 25' center to center. The new brick expansion joints should be sealed using a closed cell backer rod and a high quality elastomeric sealant.

The brick at the top of the stepped buttresses at the four corners of the building should be removed to expose what is present below the stepped brick. At that time, a decision can be made regarding a waterproofing system for the stepped tops of the buttresses.

D. <u>Marble Coping at Second Floor Parapet:</u>

We recommend that all of the existing marble copings be removed from the parapets at the second floor level. After the copings are removed, a new lead coated copper flashing system should be installed over the top of the wall below. The new lead coated copper flashing should have the outer edges hemmed to form a ½" drip edge turned down at a 45° angle. New stainless steel anchors should be installed in the existing brick parapet. A strip of self adhering flexible membrane flashing should be installed over the new anchors. The new stainless steel anchors should be fitted with a copper thimble having a flanged base extending out onto the new flashing 1". The flanged copper thimble should be sealed to the new flexible flashing using a compatible sealant material and should also receive a 4" x 4" target section of the flexible membrane material installed over the thimble and the thimble flange.

After the new flashing has been installed, the existing marble copings should be drilled from the bottom to fit over the new thimble anchors. The height of the thimble anchors should be 1-1/2" less than the thickness of the marble coping, and the holes in the marble coping should be 1" less than the thickness of the coping stones, leaving a ½" space at the top of the anchor. The coping stones should be set in a mortar bed joint on the new flashing. As the coping stones are set, two cell type weeps should be installed flat in the joint below the coping stones at each stone section. After the stones are set and the mortar cures, the joints between the marble stone sections should be sealed using a closed cell backer rod and a high quality elastomeric sealant that is compatible with the marble and is non-staining to the marble.

In conjunction with the work on the marble copings, all of the existing joints in the marble cladding on the first and second floors should have the existing sealants cut out. The joints should be thoroughly cleaned and resealed with a high quality elastomeric sealant that is compatible with the marble. As the joints in the marble are resealed, the condition of the anchors securing the marble to the structure should be evaluated. Any corrective action that may be required to the anchors should be determined at that time.

E. Windows:

The windows on the building are relatively new and are in good condition with the exceptions of the trapezoidal windows on the seventh and eighth floor. We recommend that the seventh and eighth floor windows be disassembled and rebuilt with new gaskets and fastenings to secure the fixed panels in place. In addition, the operable sashes should be removed and the operating mechanisms rebuilt or replaced. Depending upon the actual cost of repairing the windows, it may be advantageous to replace them completely in lieu of repair.

All of the existing sealants around the windows on the building have either failed or are failing. We recommend that all of the existing elastomeric sealants be removed from around all of the windows on the building. All surfaces to receive sealants should be thoroughly cleaned, primed and resealed with a high quality elastomeric sealant.

VI. ESTIMATE OF REPAIR COSTS:

We have prepared an estimate of the costs for the repairs recommended to the Asheville City Hall Building. This estimate is based on our visual observations of the existing building, our experience with similar repair projects and information furnished by a repair contractor qualified and experienced in this type of repair.

We were also asked to furnish an estimate of the cost for upgrading the existing HVAC system on the seventh and eighth floors of the building. Currently these floors are heated by steam, but have no air conditioning or air circulation system. Ventilation for the seventh and eighth floors is via operable windows.

We estimate that the cost of repairs to this building will be as follows:

A. Roofing replacement at second, seventh and eighth floors:

5,708 square feet @ $25.00/square foot................................ $ 142,700

Subtotal $ 142,700

B. Repair existing terra cotta copings and install new flashing:

1. Create new molds and furnish 50 pieces of new terra cotta $ 50,000

2. Remove copings; install new flashing and anchorages, reinstall terra cotta coping
566 linear feet @ $600 per linear foot........................ $ 339,600

3. Tuckpoint all existing terra cotta that is not removed or replaced:
Lump sum... $ 150,000

Subtotal $ 539,600

C. Brick Repairs:

1. Install new stainless steel spiral ties to secure the brick to the building:

13,624 ties @ $12.00 each...................................... $ 163,488

2. Remove the existing brick at the existing shelf angles at the third, fourth, fifth, sixth and seventh floor levels, repair or replace the existing shelf angles, extend the shelf angles where necessary, clean and paint the shelf angles, install new lead coated copper and flexible membrane flashing,

replace the removed brick and seal the joints in the brick at the shelf angles:

2,030 linear feet @ $450 per linear foot........................$ 913,500

3. Remove the existing brick at the outset corners of the vertical brick reveals on all four building elevations and install new brick to form new hidden vertical brick expansion control joints:

2,254 linear feet @ $250 per linear foot.................... $ 563,500

4. Miscellaneous brick replacement, removal of the brick above the seventh floor parapets at the rising wall conditions and replace the brick to form a vertical brick expansion control joint and tuckpoint all brick joints where the mortar is cracked or missing:

Lump Sum... $ 100,000

5. Remove the existing plaster on the brick wall between the ground floor level and existing grade on the north elevation of the building. Remove the existing outer wythe of brick and replace with new brick:

Lump Sum...$ 45,000

Subtotal $ 1,785,488

D. Marble Coping at Second Floor Parapet:

1. Remove the existing marble coping all around the second floor parapet, install new anchors, install new lead coating copper and flexible membrane flashing, reinstall existing marble coping and seal between all joints in the marble coping:

425 linear feet @ $200 per linear foot……………………	$	85,000
Subtotal	**$**	**85,000**

E. Windows:

1. Remove all existing sealants from around all existing window and door openings at all levels all around the building, clean and prime the surfaces to receive new sealant and reseal around the windows and doors:

5,320 linear feet @ $8.00 per linear foot…………………	$	42,560

2. Repair the existing trapezoidal windows at the seventh and eighth floor levels:

Lump Sum………………………………………………	$	36,000
Subtotal	**$**	**78,560**
Subtotal	**$**	**2,631,348**
General conditions (Permit, insurance, etc.)	$	263,135
Access to the building during the course of construction:	$	400,000

Contingency to cover costs of unforeseen conditions (20%)	$	658,897
Design Fees	$	395,000
Total Estimated Cost of Repair Construction	**$**	**4,348,380**

The mechanical HVAC upgrades to the seventh and eighth floors is included as a stand alone item separate from the repairs recommend to restore the weather resistance of the building. The breakdown of the anticipated HVAC upgrades is included in as Appendix B of the report.

Estimated HVAC upgrade costs.. $ 743,000

The findings of this investigation are based on information gathered through visual observation of the condition of the exterior of the building and limited information regarding the condition of the structure behind the building finishes through only approximately 12 openings made in the brick. Existing terra cotta sections were removed at only two locations and only one section of marble coping was removed to evaluate the conditions covered by these materials.

Since the information available is limited, recommendations for repairs should be regarded as a starting point. In all repair projects, more valuable information will become available as more building finishes are removed and the hidden conditions become known in greater detail. Therefore, our primary recommendation for these repairs is to begin the repairs on one side of the building with a qualified contractor who has extensive experience in the restoration of historic buildings similar in construction to the Asheville City Hall. To this end, we recommend that potential contractors who are qualified for this type of restoration be interviewed and their qualifications and past experience evaluated. Once a qualified contractor has been indentified, we recommend that a contract be negotiated with the contractor to complete repairs on one finite section of the building.

Due to the difficulties in access to this building, completion of the repairs on one full side of the building under a negotiated contract would be ideal. However, in consideration that it may not be possible for the city to negotiate a contract of this magnitude, we recommend that at least one fixed section of the building be repaired before the final design is released for bidding. The section to be repaired should be water tested before any repairs are completed and tested again after the repairs have been completed. This will establish criteria to be used as a standard for the repairs and will help to refine the estimated costs associated with the repair. Since the building is an historic structure, the proposed repair methods can also be reviewed by the City and the Historic Resources Commission to ensure that the repairs comply with their requirements and do not detract from the historic nature of the building.

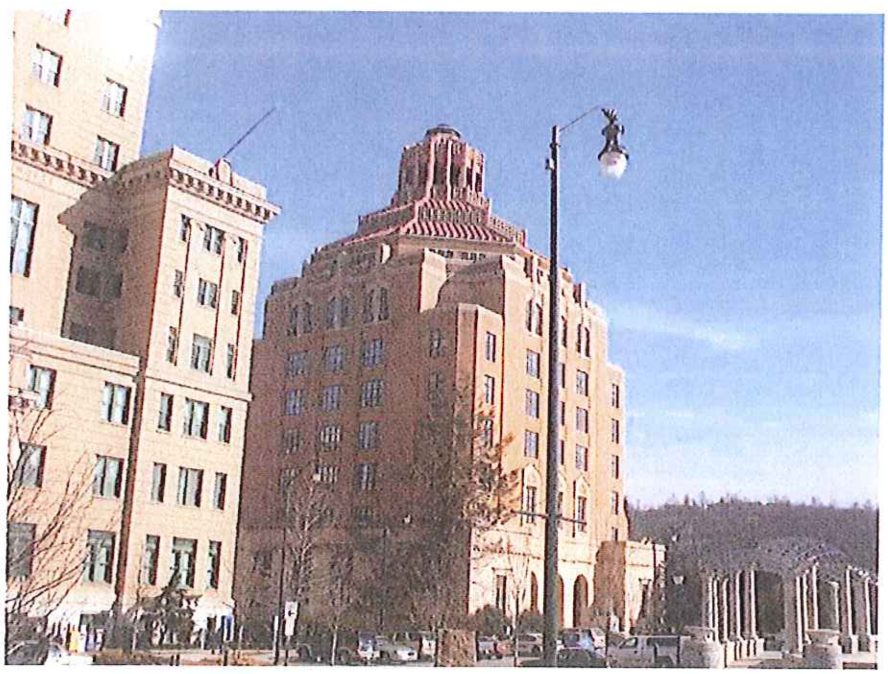
In consideration of the complexity of the repairs recommended on this building, the historic significance of the building, and the highly specialized nature of the repairs, there are not that many contractors who are qualified and capable of carrying out the project. In addition, any terra cotta units that require replacement will need to have specially made replacements manufactured. There are few companies remaining with the expertise to achieve the manufacture of a quality replacement terra cotta material. Lead times for manufacture of replacement terra cotta can be as long as a full year. It may also be necessary to have replacement brick fabricated to match the existing brick.

It should be noted that this investigation was to include an evaluation of the seventh and eighth floors of the building assessed for mold contamination. We did have this evaluation completed and no significant mold growth was detected. However, we are aware that the City has also had a separate and more in depth mold assessment completed on the building since the beginning of this project. Therefore, we are not including the mold contamination evaluation that we had completed as a part of this report. We believe that the report obtained by the City Risk Management Department should be consulted in this regard.

Appendix A

Photographs

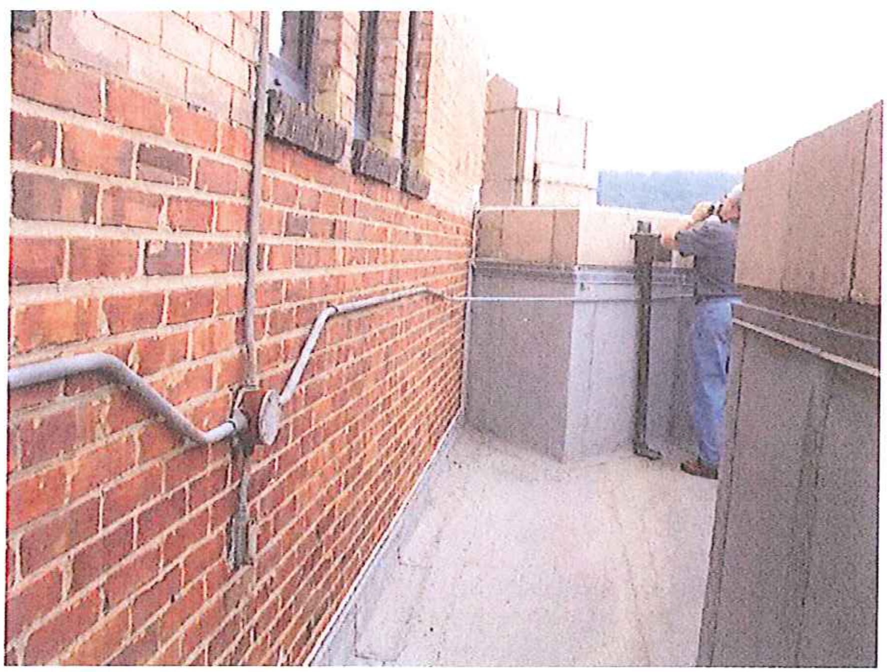
1. A view of the west elevation of the building. The various cladding materials are visible as well as the tiered configuration of the design of the building.



2. A view of the northwest corner of the building showing the north and west elevations. The octagonal roof and the stepped back roof areas are visible in this photo.

COPY

3. A view of the southeast corner of the building. The ramp leading to the basement area is visible in the foreground including the curved retaining wall at the southeast corner of the ramp area.



4. A view of the roof at the eighth floor level showing the different brick used at the building wall that is hidden from view. The typical terminations of the roofing membrane are also visible. Note the roofing membrane continuing up the inside face of the parapet.

COPY

5. A view of the roof at the second floor level on the north side of the building. The roofing at this location also extends up the inside face of the parapet. The marble coping on the parapet is also visible showing and elastomeric coating on the inside face of the coping.

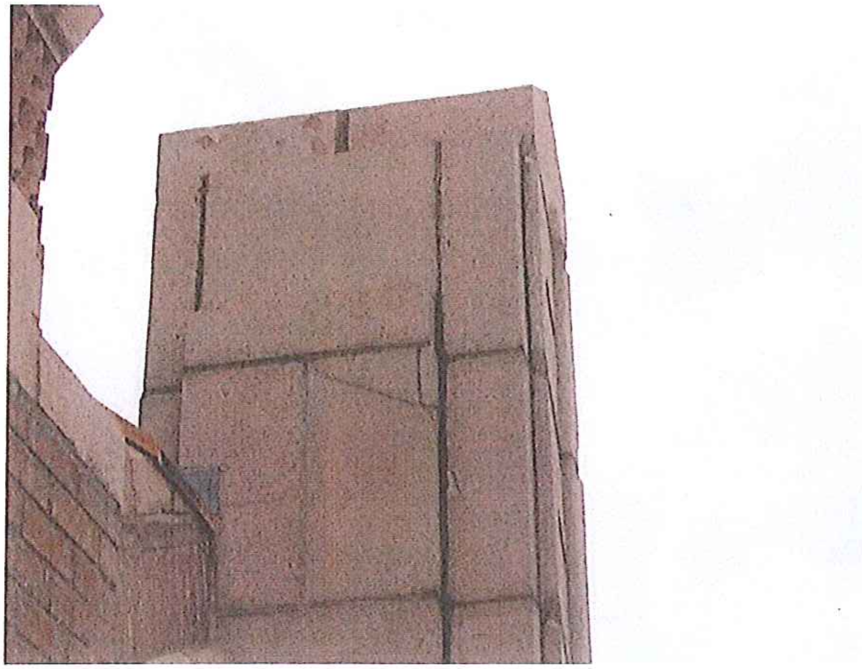
6. A view of the concealed gutter at the eighth floor level. It is believed that the gutter was lined with lead coated copper in the early 1990's.

7. A closer view of one of the flashing conditions at the concealed gutter showing a void area that can allow water to enter the building.

8. A view of the decorative brick work and terra cotta just below the octagonal roof. Note the corrosion on the flashing at the lower wall.

9. A general view of the brick and terra cotta configuration at the eighth floor level.

10. A closer view of the brick and terra cotta. Some of the damaged terra cotta is visible as well as the remains of a black surface applied sealant that was previously installed over the mortar joints in the brick and the terra cotta.



11. A view of one of the terra cotta piers just above the eighth floor showing cracks in the terra cotta and some spalling of the glaze on the terra cotta.

12. Another view of the general configuration of the brick and terra cotta at the eighth floor level. The same typical conditions are present on the brick and terra cotta including cracks in the terra cotta and the black surface applied sealant material.

COPY

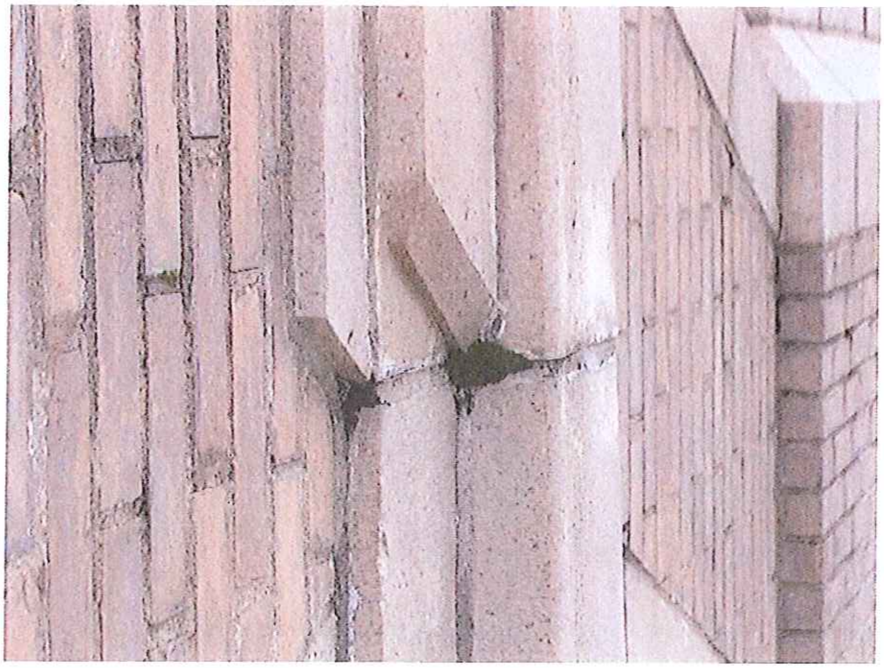
13. A section of the terra cotta coping at the seventh floor level that was previously repaired. The upper repair was made using an epoxy material and the lower repair was made using mortar. Both of the repairs are failing.

14. The mortar joint below the terra cotta coping is cracked. Water running off the terra cotta can be pulled into the joint due to capillary action.

15. Cracking in the mortar joint below the terra cotta and some mortar that is falling out of the joint.

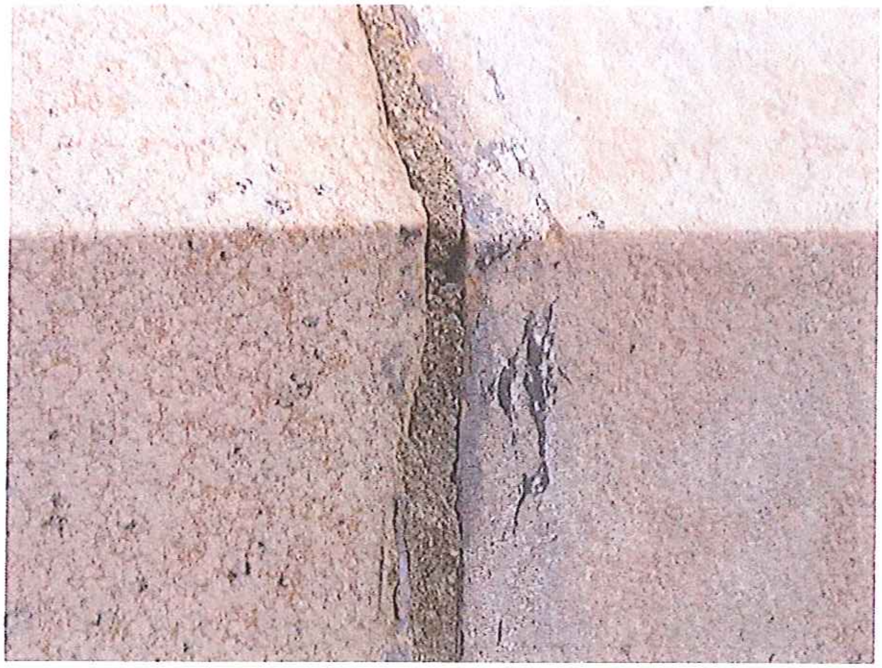
16. A section of chipped terra cotta showing traces of water seepage from above.

COPY



17. Moss growth in the mortar joints in the terra cotta.

18. A view of some of the terra cotta showing spalling of the glazing, cracks in the terra cotta and missing mortar in the joints.



19. A typical mortar joint between the terra cotta coping showing separation between the mortar and the terra cotta units. These cracks allow water to penetrate into the top of the wall.

20. Another location where mortar is cracked or missing in the terra cotta and brick construction.

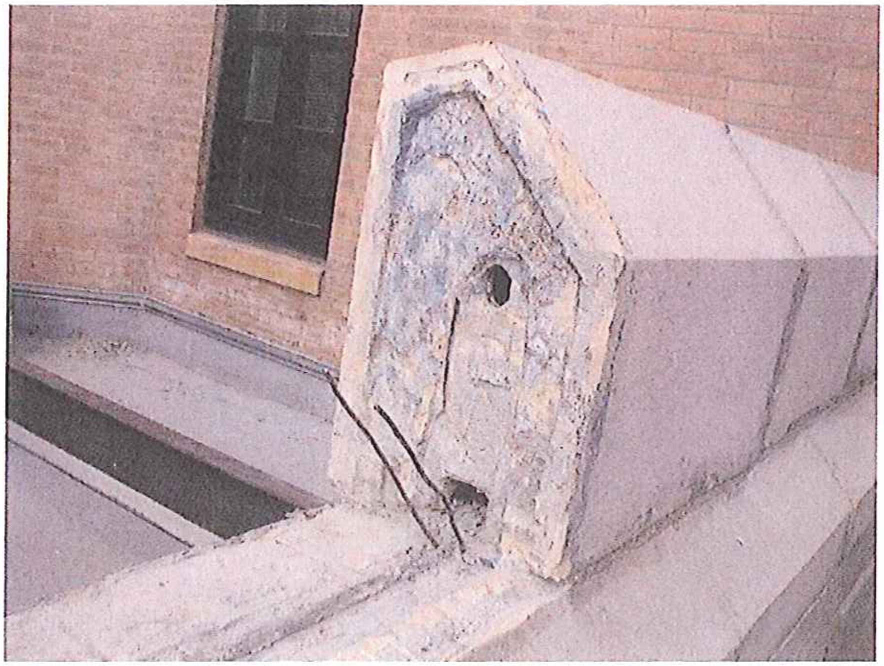
21. An area of the terra cotta coping after rain the previous day. Failing repairs in the terra cotta can be seen as well as water weeping out of the mortar joints.

22. A view of the terra cotta anchorage on the north wall at the northeast corner of the building. The anchor wire at this location wraps into the mortar joint, but does not wrap around the anchor bar below. Note that the mortar is wet at this location. Water was discovered as the terra cotta unit was removed.

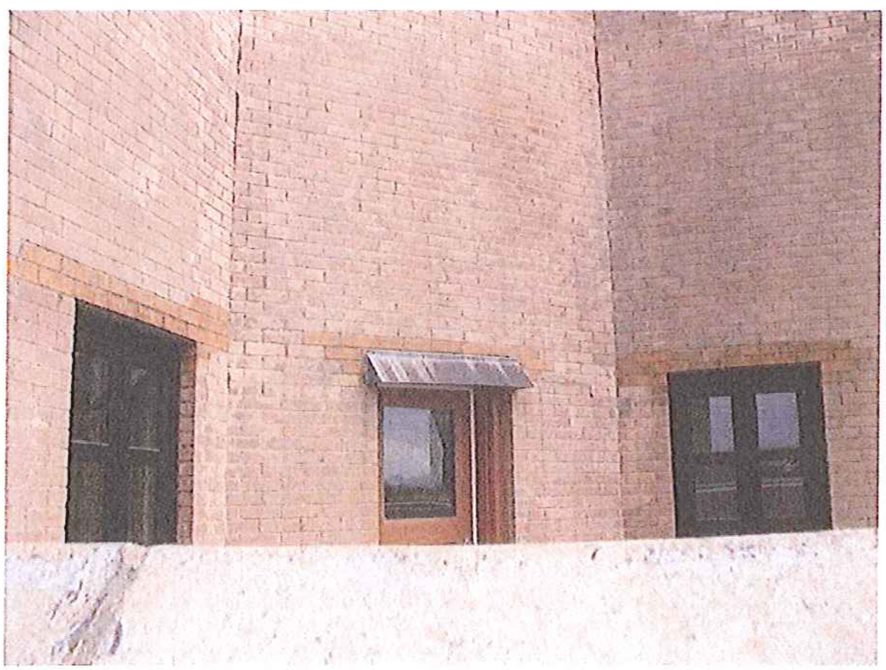
23. A section of terra cotta was removed at the northwest corner of the seventh floor. This photo shows the anchor bar running below the terra cotta coping and the anchors securing it into the wall below.

24. One of the anchors securing the anchor bar in place. There is severe corrosion of the anchor bar at this location.

COPY

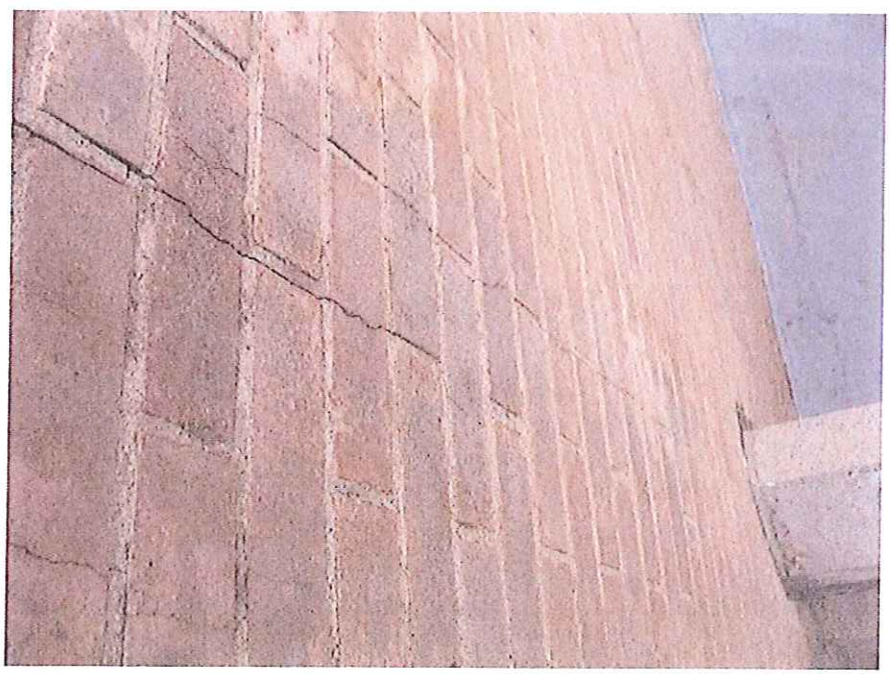


25. A view of what is believe to be a bronze anchor wire used to secure the terra cotta coping to the continuous anchor bar. The wire wraps around the anchor bar and extends into the mortar joint between the terra cotta units.



26. Some of the brick that was previously replaced above the window and door openings at the stepped roof level at the seventh floor. No flashing or weeps were noted in the brick that was replaced at this location.

27. A vertical crack in the rising wall at the seventh floor level. At this location, the brick on the outside of the building extends from the second floor upward while the rising wall is supported at the seventh floor level. This creates differential movement in the brick. This condition is typical at all of the rising wall conditions.



28. Another view of a rising wall condition looking down from the eighth floor to the seventh. Note that the location of the crack in the wall aligns with the location of the parapet below.

29. A view of some of the brick on the building showing extensive moss growth on the mortar joints. The growth of moss generally requires a damp location with a relatively constant source of water.

30. One of the locations where brick was removed to view the condition of the structure behind the brick veneer. The shelf angle has a significant amount of corrosion present. There is no flashing at the shelf angle and no weeps were found in the brick.

31. The shelf angle at this location supports approximately one half of the width of the brick. Standard practice is for the brick to bear at least two-thirds the width of the brick onto the shelf angle. Also, there is no expansion joint in the brick at the shelf angle.

32. Another inspection port in the brick showing corrosion of the shelf angle, no flashing and no expansion joint in the brick at the shelf angle. This location was wet when the brick was removed.

COPY

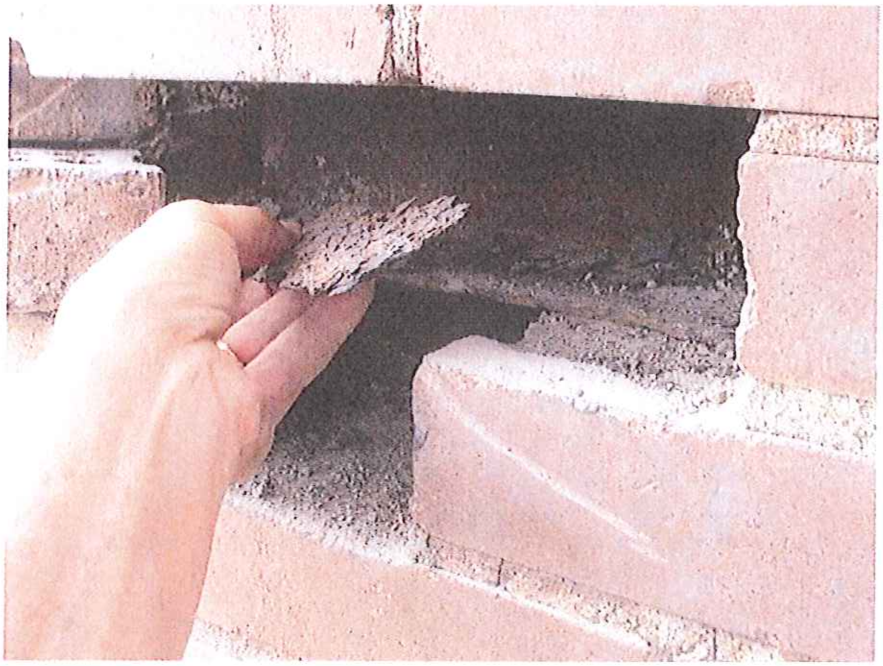
33. The remains of a corroded brick tie found when the brick veneer was removed.

34. Another brick inspection port opened in the brick veneer. Water that had collected on the shelf angle ran out when the brick was removed.

37. The shelf angles in the rising walls stop where the wall turns in onto the inset roof areas.

38. An inspection port opened near the southwest corner of the building. The shelf angle is heavily corroded and scaling. The material on the shelf angle is exfoliated steel from the vertical leg of the shelf angle.

COPY



39. An example of severe corrosion of the shelf angles on the building. While the corrosion by-product occupies a much larger volume than the parent metal it comes from, this represents a very serious condition that can adversely affect the stability of the brick veneer.

40. The brick at east sixth floor window at the southeast corner of the building is supported on the shelf angle less than 1". It was noted that the brick was previously replaced at this location, and is bowing outward above the window. No brick ties, flashing or weeps were found. It is our opinion that the brick is very unstable at this location.

41. Another window opening on the south wall of the building where the brick is not adequately supported by the steel shelf angle.

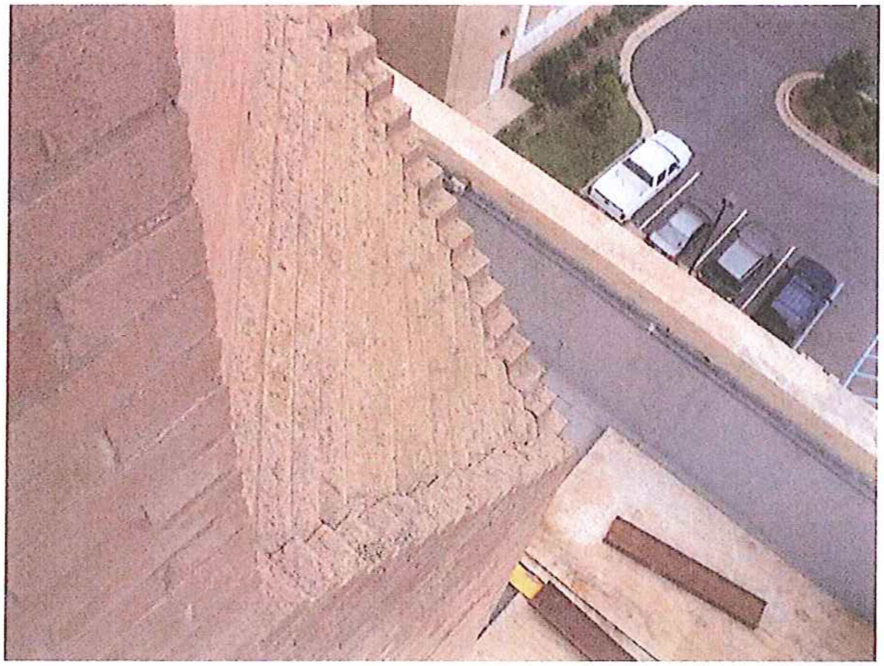
42. A view of the same window opening shown in photo 41. The brick is barely supported on the shelf angle.

43. A view of the southwest corner of the building where the brick is mitered at a 45° angle. The mortar is cracked and some of it is missing from the brick bed joint at the shelf angle location.

44. There is a vertical crack in the brick where the southwest mitered corner meets the brick on the west wall of the building.

45. A closer view of the crack seen in photo 44. There are no vertical brick expansion joints to allow differential horizontal movement in the brick on the building.

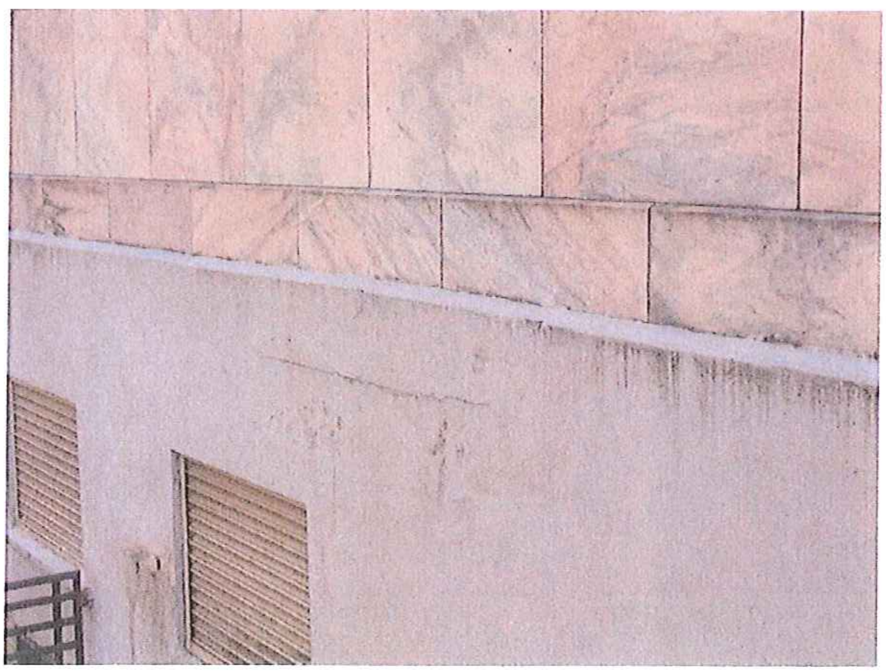
46. Horizontal cracks in the brick at the shelf angle locations on the west face of the building.



47. The top of the brick buttress at the southeast corner of the building. The brick steps down away from the building at these buttresses, and there is a crack between the brick at the vertical sides of the buttress and the stepped brick on top.

48. A closer view of the crack in the brick at the top of the buttress shown in photo 47. A significant amount of water can enter the brick at these locations which are typical at all four corners of the building.

49. An area of brick at the base of the building at ground floor level where the brick is covered with a cement plaster. The plaster and the brick are spalling at this location due to freezing water trapped behind the plaster.

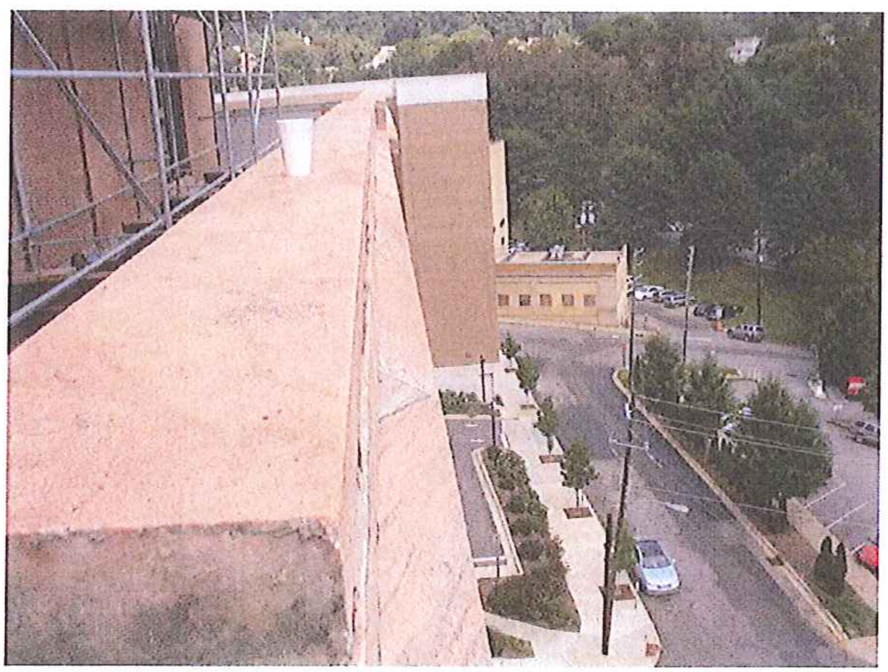


50. Another area in the plaster over the brick at the ground floor level where the plaster is failing. Eventually, this area will spall away similar to the condition seen in photo 49.

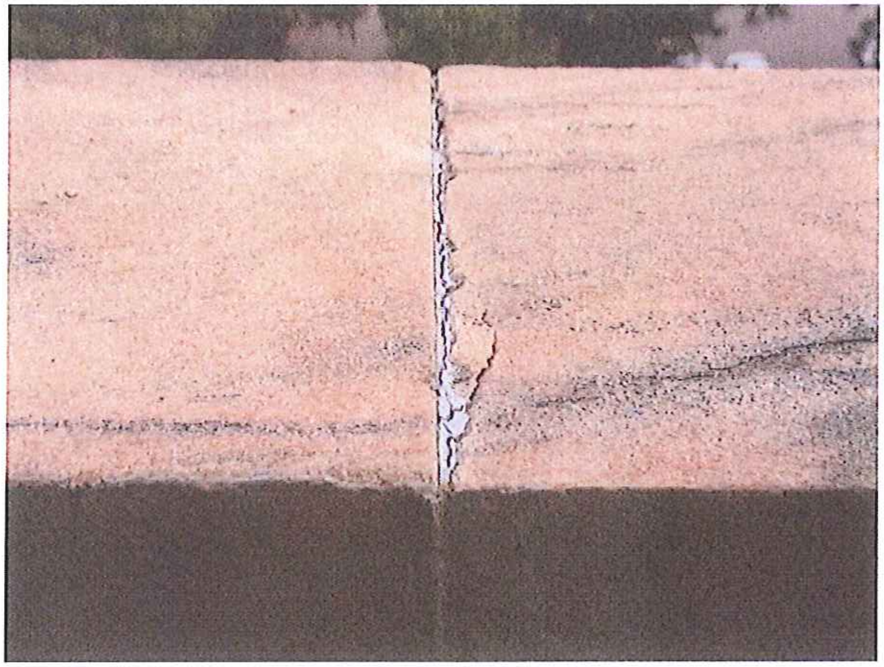
51. Cracks in the brick veneer on the east wall of the building below the ground floor level.

52. A closer view of the cracked brick veneer seen in photo 51.

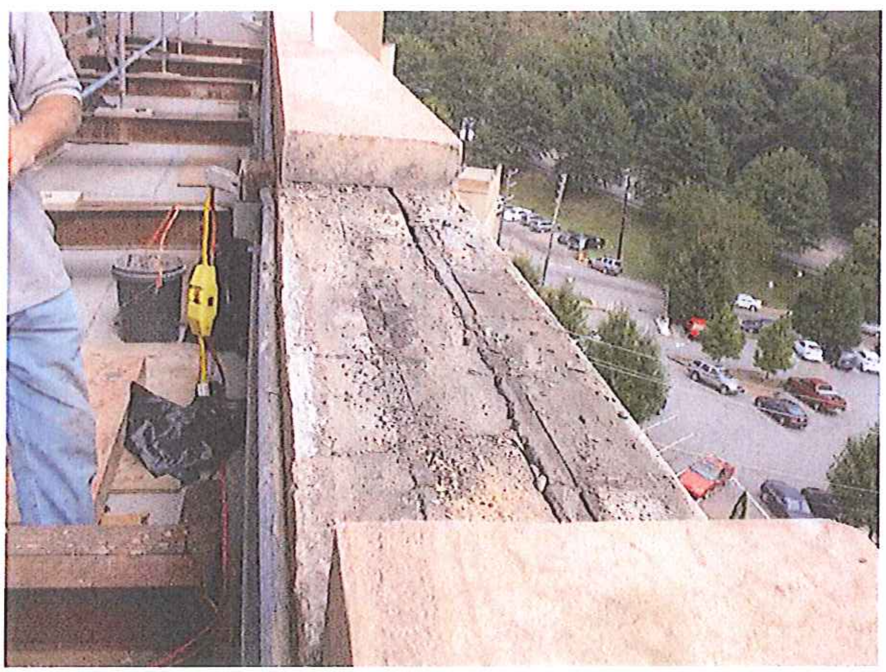
53. Cracks in the circular brick wall at the vehicle ramp at the southeast corner of the building.



54. The top of the parapet at the second floor level on the south side of the building. It is not readily visible from the photo, but the lower portion of the marble is bowing away from the building along this wall.



55. A typical joint between the marble coping stones on the second floor parapet. The sealants in the joints have failed, and the marble is beginning to spall at this location.



56. A section of the marble coping was removed from the top of the second floor parapet on the south side of the building. There is no flashing below the marble coping. Note the separation of the outer wythe of marble below the coping. It is estimated that the outer wythe of marble has moved outward approximately ½" at this location.

57. The typical condition of the sealants around the trapezoidal windows at the eighth floor level. The sealants between the window frame and the terra cotta have failed completely.

58. A closer view of the failed sealants between the terra cotta and the frames of the trapezoidal windows.

59. Failed sealants at the jambs of the trapezoidal windows at the eighth floor level.

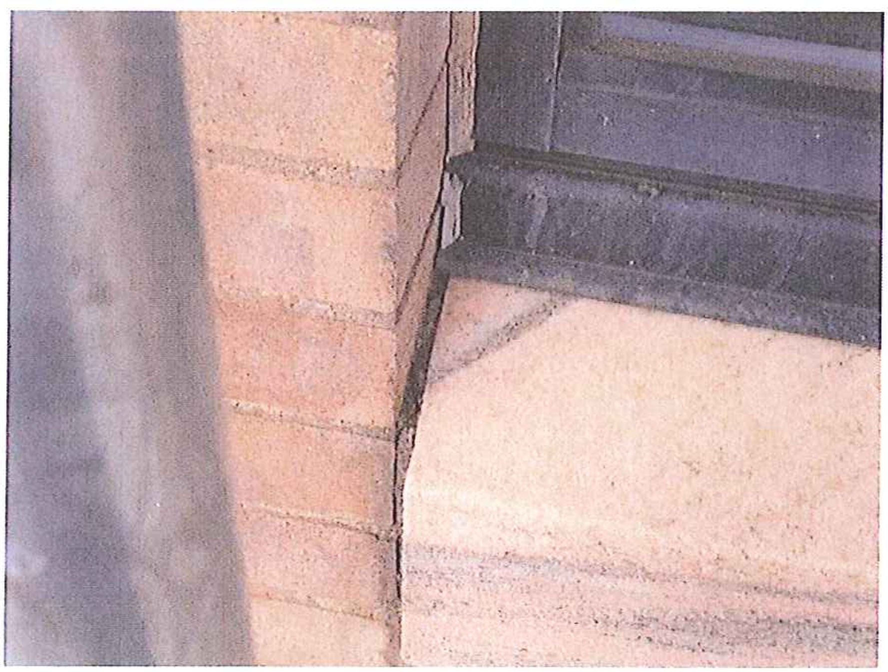
60. The window operating mechanisms of the trapezoidal windows has failed. This condition was noted on the north and south sides of the building. Deterioration of the mortar in the terra cotta jambs is also seen in this photo.

COPY

61. A view of the sealant joints at the bottom of the trapezoidal windows. The sealants have all failed allowing water to enter the building.

62. A sealant installed over the face of the mortar joint between the brick and the shelf angle above a rectangular window on the south wall of the building. Placing a sealant joint over the face of the shelf angle traps any water that enters the wall above the window.

63. The sealants around all of the windows on the building have typically failed.



64. The sealants at the marble window sills have failed where they exists typically. At many locations such as this one, there is no sealant. The mortar joint between the brick and the marble sill is typically cracked, allowing water to enter the building.

65. A view of the damaged interior finishes on the eighth floor at the southeast corner of the building.

66. Some of the damage present due to water intrusion at the eighth floor level.

Appendix B

HVAC Upgrade Estimate

HVAC Renovations of the 7th and 8th Floors

The renovations of the 7th and 8th floors will need to be carefully planned to accommodate the needs of the HVAC systems. A Mechanical Room will be needed on each floor for new air-handling units. The AHU's would serve each floor and each zone would have a variable air volume (VAV) box with hot water reheat coils. Outside air will need to be provided for ventilation purposes. Locating the outside air louvers will require close coordination to make sure that they are not visible and impact the aesthetics of the building.

The building is currently served by an air-cooled chiller that was reported to be sized to handle a future renovation of the 7th and 8th floors. It is assumed that the chiller has adequate capacity for the 7th and 8th floors. A new chilled water riser and pump will need to be installed to serve the upper floors. The existing boilers have adequate capacity to accommodate the HVAC renovations proposed. Hot water will be taken to the renovated areas to provide reheat on the VAV boxes.

Our opinion of cost to provide a new HVAC and DDC controls system for the renovated area is $375,000. The engineering fee is estimated to be $33,000 and the construction cost is estimated to be $335,000.